Smart Distributed Wind Farm by 500kw

1. Background

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1.1 Local grid condition of wind farm

- Three Phase 63Kv @ 50Hz (or dependent upon the grid system)

2. Bigger is not always better

One of the most pervasive myths today is that bigger is better, that potential economies of scale can be attained and that costs can be better amortized across a large asset base. This belief has wide subscription in the global wind energy business and may well be true in some circumstances, most particularly offshore wind. But not all are.

What is a DWF? It is not a very big capacity wind farm and rather a smaller capacity wind farm with some medium size wind turbines in one location. It has the capability for timely onsite maintenance and repair of any of the turbines which comprise the wind farm. The core elements that make a collection of discrete individual wind turbines into a collective entity known as a wind farm is an automated remote management system shared by all turbines giving a single logical view of the wind farm.

3. Smart Distributed Wind Farm (SDWF)

DWF is based on the advanced state of the sensor and artificial intelligence technology to directly monitor and protect the distributed wind power, ensuring that the distributed wind power is absolute safe, environmentally friendly, and efficient. So, DWF not only contains medium size wind turbine, they must have many various types of sensors, such as wind speed, voltage, current, power, frequency, and vibration sensors to ensure the turbines normal and safe operation.

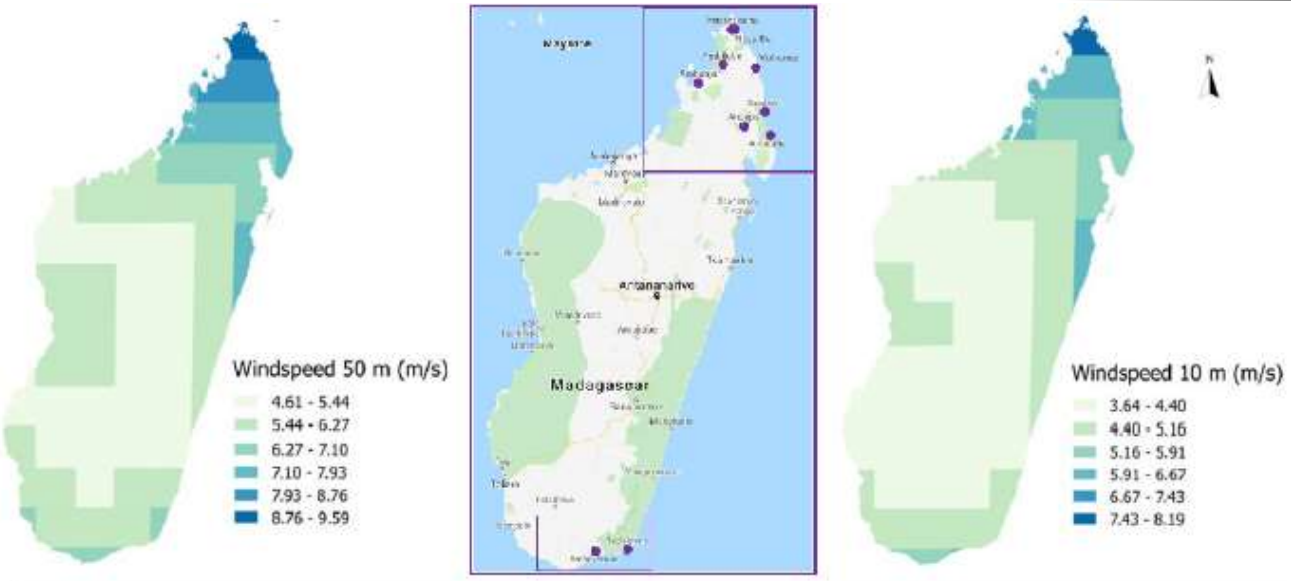
DWF facilitates the installation of a single turbine wherever a favorable set of circumstances prevail but without losing the scale advantages that accrue to a large conventional wind farm operator. Many disparate geographical locations are less susceptible to low wind conditions overall.

In addition to directly providing power to the terminal power users, the smart distributed wind power generation system can also connect the distributed power generation system into the grid in the form of a microgrid, and operate in parallel with the high voltage grid, supporting each other, and effectively utilizing the power utilization structure. Adjusting the peaks and valleys of power consumption, reducing the load pressure of power grids during peak hours and promoting the optimal allocation of power resources are the most effective ways to utilize the efficiency of distributed wind power generation systems.

The introduction of distributed generation will cause a fundamental change in the structure of the distribution network, mainly because the introduction of distributed generation has completely changed the traditional distribution network planning and operation (such as reactive power compensation, voltage control, etc.).

4. The position selection of DWF

Madagascar is an island country with huge reserves of wind energy resources and excellent distribution of wind resources in the north, east and south. It is suitable for the establishment of distributed wind power stations. According to current conditions, we can set up many small size capacity of SDAWT such as 1MW to 5MW.



Region	Locality	Potentiality(m/s)
Atsimo Andrefana	Itampolo, Androka, Tanjona, Ambohimena	8 to 9
Androy	Tsihombe	8
Anosy	Lokaro a tolagnaro	8 to 9
Diana	Nosy Be, Cap Diego and Antsiaranana	9
Sava	Sambava, North of Antsirabe and Manambato	7.5

5. Medium Size Wind Turbines of DWF

To make the DWF a reality, the key strategy is to utilize medium size wind turbines with the general specification the wind turbines need to have to, at a minimum, the following characteristics: high power generation efficiency, width power generation wind speed range, strong self-protection, safety and low noise

6. Wind Turbine selection

According to the conditions of DWF, the best solution is to choose the 500kw Vertical Axis Wind Turbine （VAWT）of Talos Industry Corporation.

6.1 The features of Talos 500kw VAWT

High power generation efficiency. Talos's 500kw vertical wind turbine use "Active Real-Time Pitch Angle Regulation" Technology. Each blade's angle will be controlled independently by a motion controller according to blade position, wind direction, wind speed and the power of turbine, maximizing the power control of turbine.

With this technology the turbine not only operates with high power generation efficiency, but also strong safety protection in extreme weather conditions.

6.2 Features of Talos 500kw turbine.

Because "Active Real-Time Pitch Angle Regulation" Technology was used in this turbine, when the grid is at the peak of power consumption, the wind turbine can maintain the best power generation status to generate the maximum amount of power. When the grid is at low electricity consumption, and the wind is strong, it can be monitored so that the wind turbine does not need to maintain the maximum power generation status, and the protection of the power grid is realized from the wind turbine side.

6.3 Basic function

- High power generation efficiency
- Wide power generation wind speed range
- Active power and reactive power regulation
- Low voltage ride through capability
- IEC 61400-2 Class II standard

6.3 Additional advantage of Talos 500kw VAWT

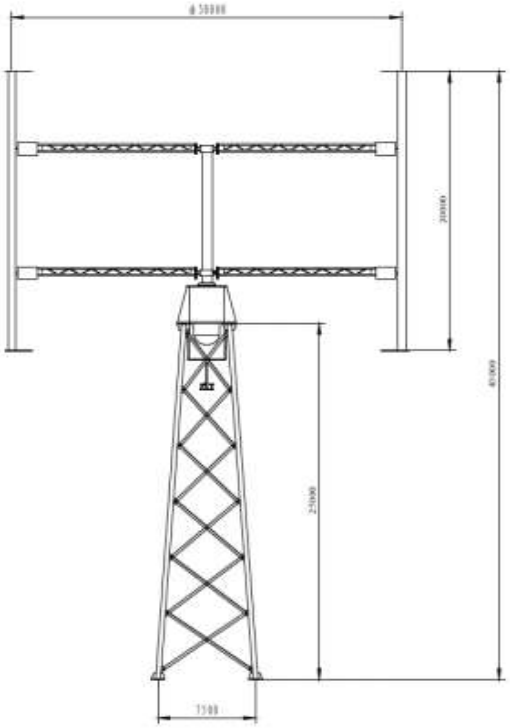
- Quiet Operation
- More Safety Features
- Bird Friendly
- Wonderful Performance at Lower Wind Speed
- Captures Wind from All Directions
- Longer Life
- Less Maintenance
- Smaller Foundation
- Lower Supporting Tower

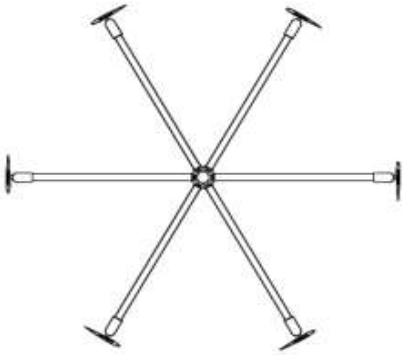
6.4 Turbine data

- Rated power 500kw
- Max power 550kw
- Rated wind speed 12 m/s
- Cut in wind speed ≤2 m/s
- Cut out wind speed ≥25 m/s
- Active real-time pitch angle regulation for over speed control
- Auto compressed air brake system
- PMG 690V/three phase
- IEC 61400-2 Class II

Compressed air brake system, safety & environmental protection

6.5 Turbine structure:



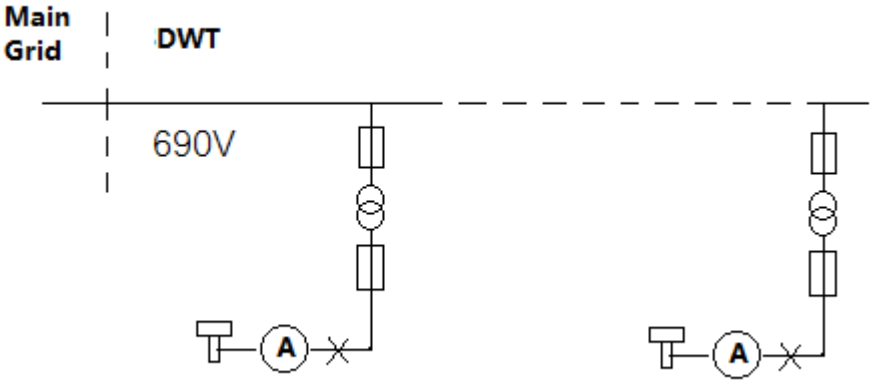


6.5 Daily power generation at different average wind speed

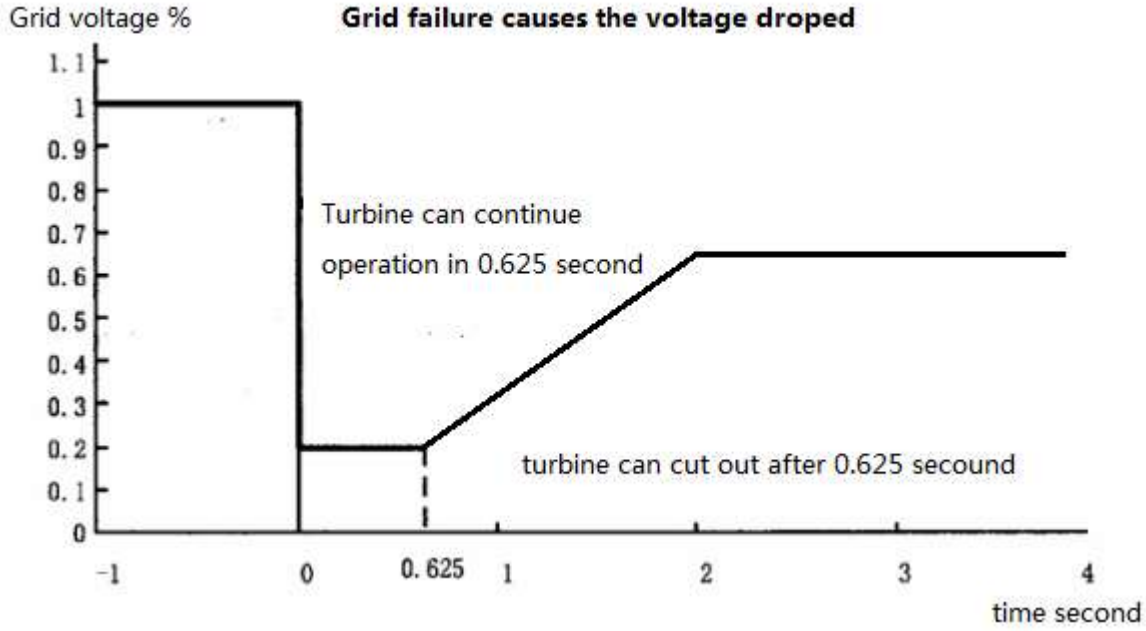
Average Wind Speed (m/s)	2	3	4	5	6	7	8	9	10
Production (kWh)	120	383	858	1,567	2,471	3,483	45,000	5,455	6,280

7. Grid Protection

For a 5mw DWF, it will use relay cut-off protection. Each turbine has a 690v circuit breaker for regional protection.



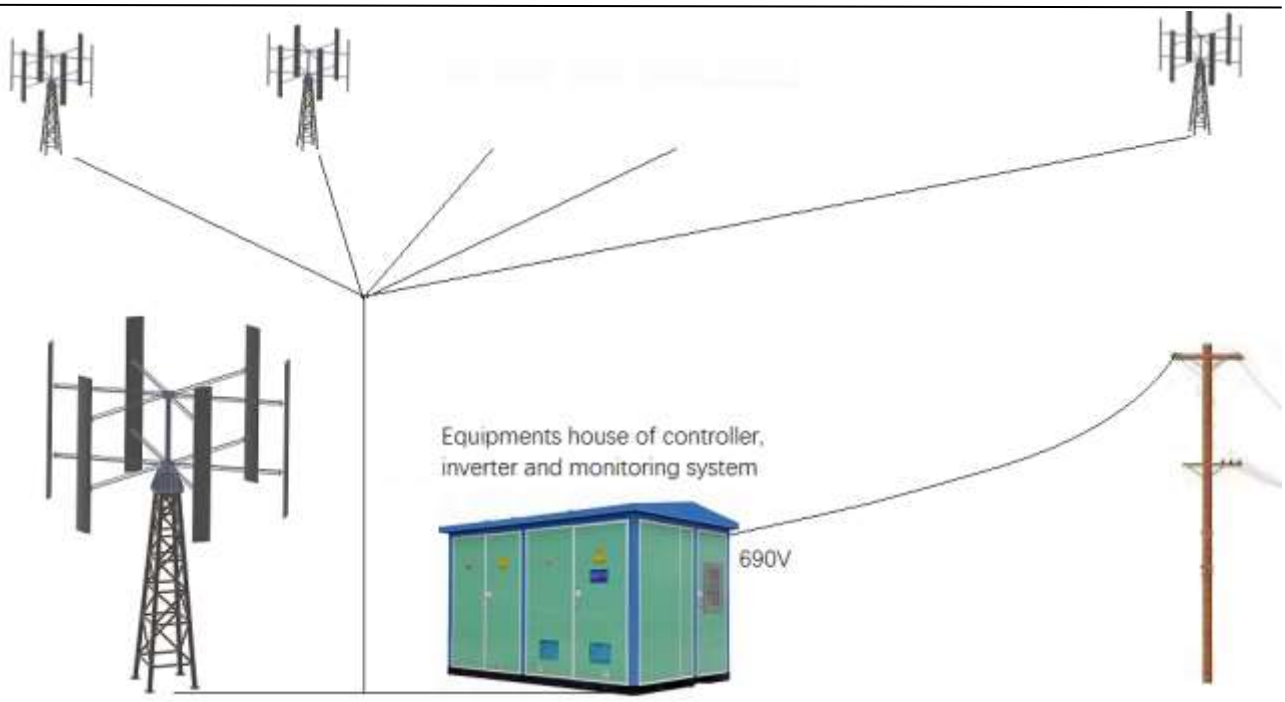
The wind turbine has low voltage ride through capability though the on-grid inverter of turbine.



8. Grid Access (active & reactive power compensation)

Access point

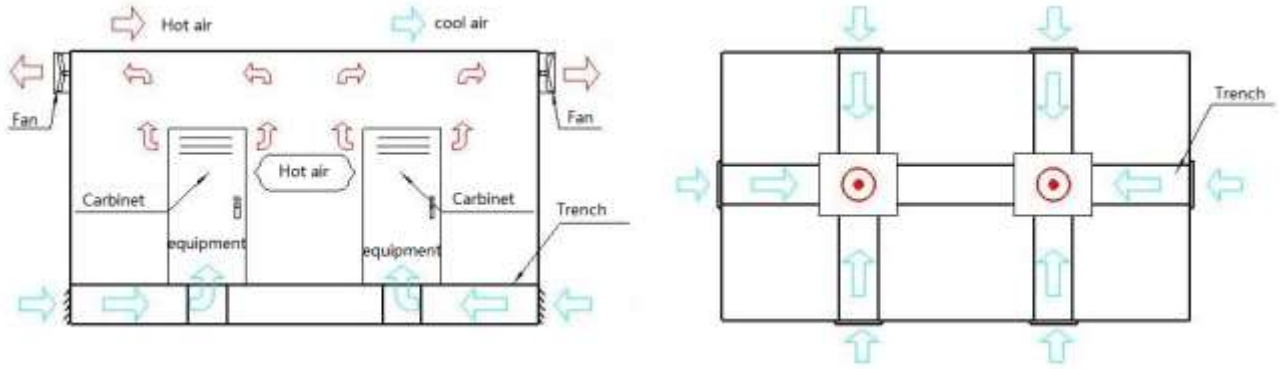
This system is from AC to DC to AC to AC raise voltage by boost substation to the main grid. There are two class monitoring. Turbines monitoring and wind farm power monitoring.



The wind farm access will meet the requirements of grid company and meet following conditions.

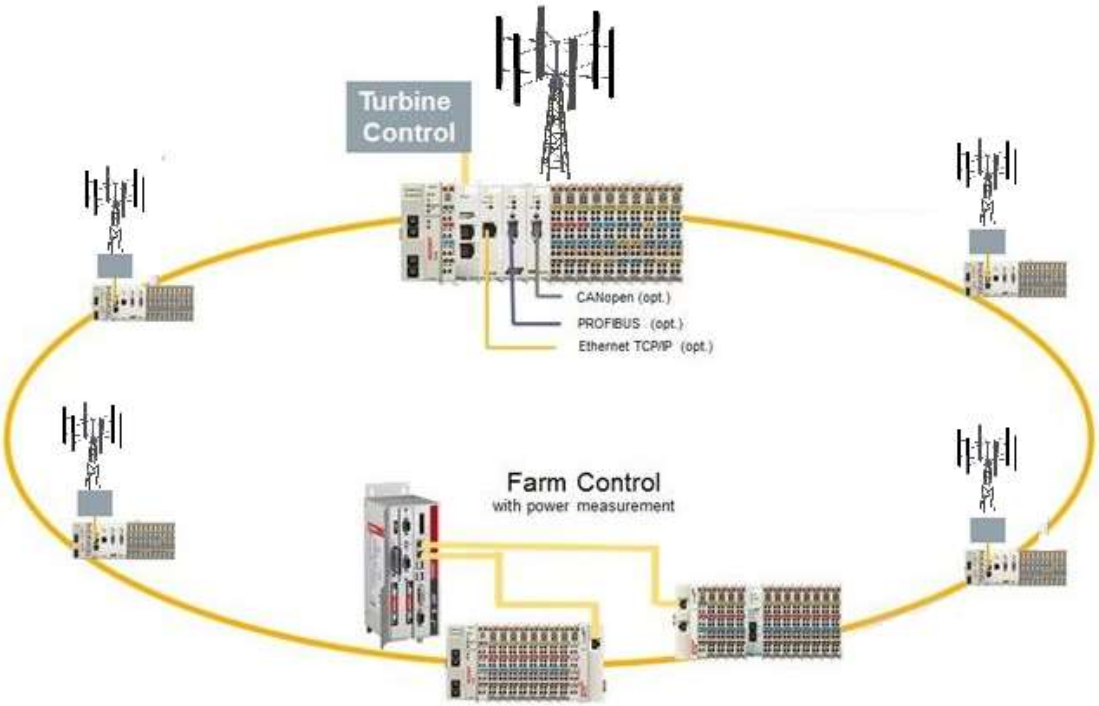
- The voltage change range will be 2.5% to -6.5% (or discuss)
- The frequency change range at different status of grid will be reach:

49Hz-49.5Hz	Turbine operate at least 10 min when the frequency lower than 49Hz.
49.5Hz-50.2Hz	Continue operation
50.2Hz-51Hz	Turbine operate at least 2 min when the frequency higher than 50.2Hz
＞51Hz	Turbine cut out step by step after the frequency higher than 51Hz



9. DWF Monitoring & power management of wind farm

Below is a series of real-time network solutions for wind turbines and wind farms.
This solution has powerful wind farm power monitoring capabilities. The platform provides an interface with the power grid to centrally control the voltage, current, frequency, power, electricity etc. of the wind farm in real time. Ensure that the wind farm and the access area grids work in harmony with each other to achieve efficient wind farm operation and management.
The dedicated power measurement terminal module cooperates with the unique low voltage ride-through control module to monitor the power grid status (voltage, frequency, active power, reactive power, etc.) of the public access point of the wind farm grid and the grid side of the single wind turbine.

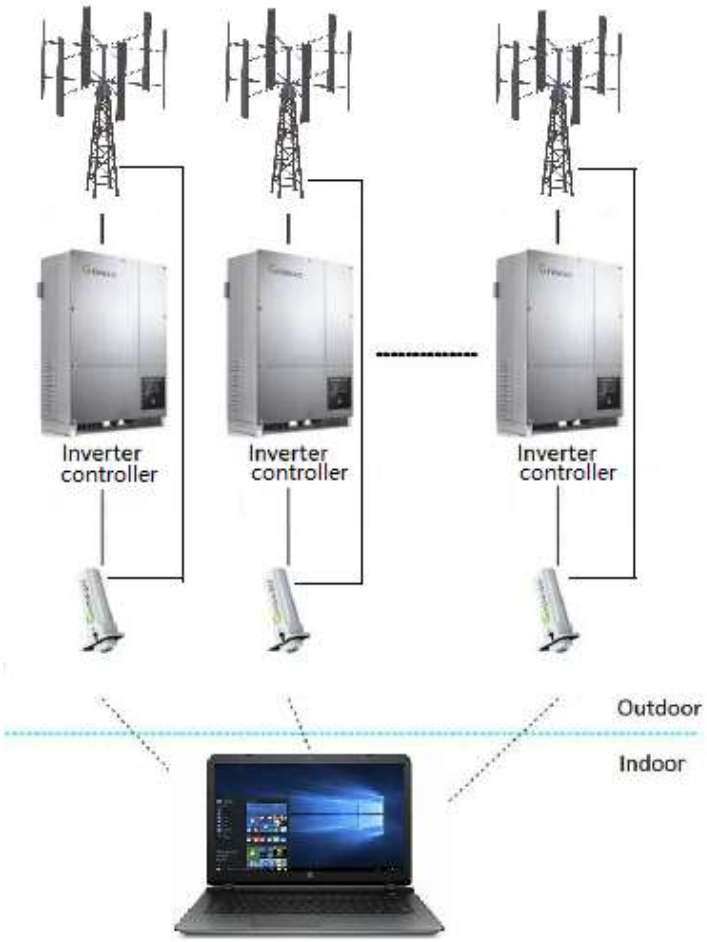


Wind farm power monitoring is divided into two parts in real time.

9.1 Single turbine real-time monitoring network (shown below)

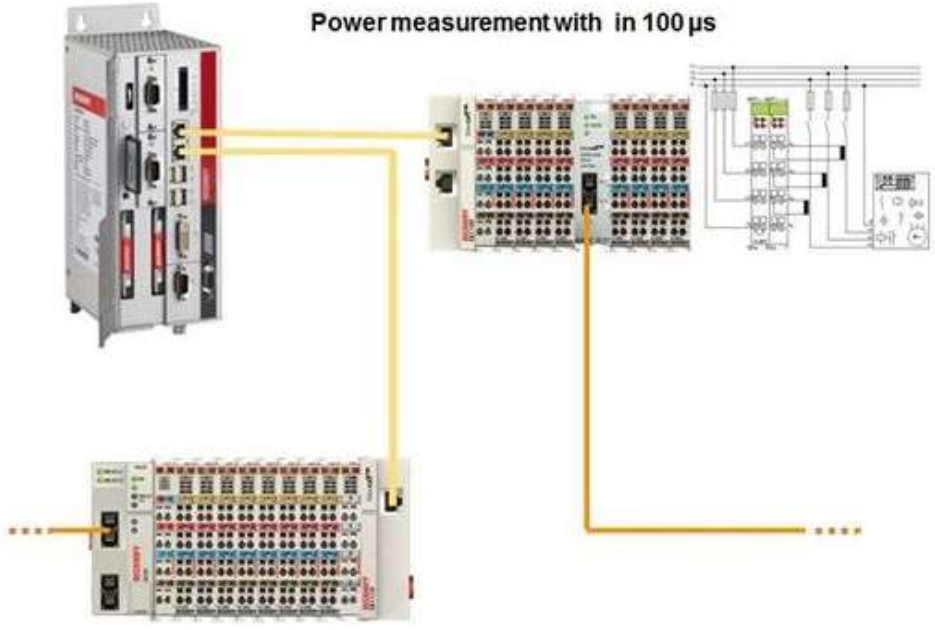
In this design plan, the main control program controls the output voltage, frequency and power of the fan according to the current wind conditions and the control commands of the wind farm energy management platform to ensure the stable operation of the turbine.

The controller's own Ethernet interface can be connected to the switch module EL6601 to meet the real-time control needs of the entire wind farm. It can directly monitor the inverter output data such as voltage, current, frequency, active power, reactive power, power generation on the grid side of a single wind turbine. The wind turbine main control system monitors the operation status of the wind turbine through the collected power data, and the related data can be transmitted to the energy management platform of the wind farm central control room through the wind farm network.



9.2 Wind farm power real time network

The power measurement module monitors the public access points of the grid of wind farm, and the grid status of each wind turbine side, and regulates the voltage, frequency, active power and reactive power of the entire wind farm through the platform-specific control program（see below）



10. Installation & Maintenance

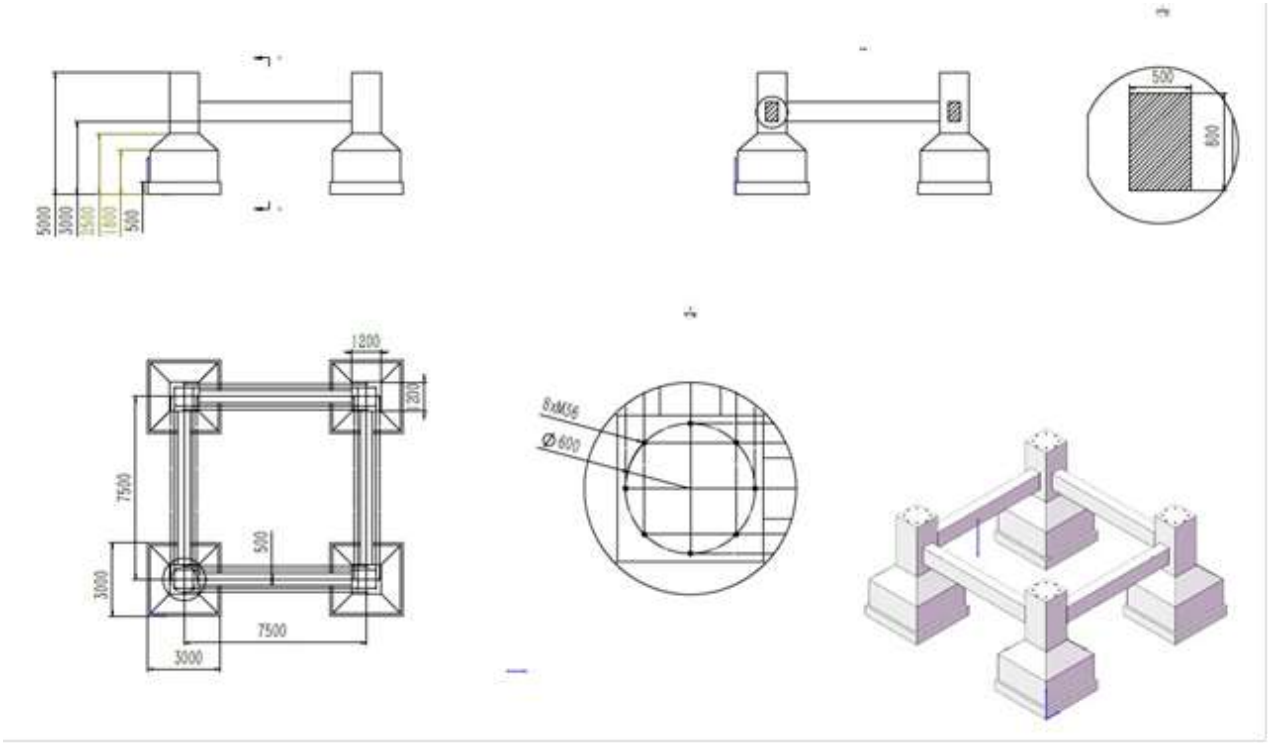
The installation needs professionally trained and licensed teams by Talos industry Corp. and the guidance of Talos's engineer.

10.1 The installation tools

The installation needs a 50ton crane, a 25m ascending car. Other tools will follow the products.

10.2 The installation laborer

The installation is divided into two stages. The first stage is to make the foundation according to below design drawing. Usually the maintenance period is 2 weeks after the foundation is completed. The first stage needs around 2-3 workers. The second stage is installation. In this stage usually, 7-8 workers, and one professional electrician or engineer to perform the wiring.



10.3 Cable& wire

The power cable capacity will according to the current, voltage and the distance between turbine to grid. The control wires and controller to inverter cables don't need to prepare.

11. Construction cycle.

It will be a turnkey project. The total construction cycle will be 12 months including manufacturing, transportation, installation and equipment debugging cycles + 2 months contract execution period. The manufacturing cycle will be 8 months. The shipping cycle will be 2 months. The installation and debugging cycles will be 2 months.

Thank you